Taiwanese Journal of Obstetrics & Gynecology 54 (2015) 493–498

Contents lists available at ScienceDirect

Taiwanese Journal of Obstetrics & Gynecology

journal homepage: www.tjog-online.com

Original Article

Temporary prophylactic intravascular balloon occlusion of the common iliac arteries before cesarean hysterectomy for controlling operative blood loss in abnormal placentation

Min Min Chou [a, b, c, d, *, 1], Hsiao Fan Kung [a, 1], Jen I Hwang [e], Wei Chi Chen [a, d], Jenn Jhy Tseng [a, d]

[a] Department of Obstetrics and Gynecology, Taichung Veterans General Hospital, Taichung, Taiwan
[b] Chung Shan Medical University, School of Medicine, Taichung, Taiwan
[c] School of Medicine, National Yang Ming University, Taipei, Taiwan
[d] Department of Nursing, HungKuang University, Taichung, Taiwan
[e] Department of Radiology, Taichung Veterans General Hospital, Taichung, Taiwan

ARTICLE INFO

Article history:
Accepted 14 March 2014

Keywords:
abnormal placentation
arterial thrombosis
balloon occlusion
cesarean hysterectomy
common iliac arteries

ABSTRACT

Objectives: The purpose of this study was to investigate the efficacy and safety of temporary prophylactic intravascular balloon occlusion of the common iliac arteries (CIA) before planned cesarean hysterectomy for controlling operative blood loss in abnormal placentation.

Materials and methods: A retrospective study of 13 pregnant women at risk for placenta accreta identified using sequential obstetric ultrasonography and magnetic resonance imaging from January 2007 to December 2009 was performed. Temporary prophylactic intravascular balloon catheterization of the bilateral CIA before cesarean hysterectomy was performed by interventional radiologists. The maximum duration of occlusion time of CIA must not exceed 60 minutes. The primary outcome for this study included estimated blood loss and secondary outcomes included the development of thromboembolism, disseminated intravascular coagulation and surgical complications.

Results: Among these13 patients, the mean age of the patients was 32.8 ± 0.7 years (range 29–37 years). The mean gestational age at cesarean hysterectomy was 32.2 ± 0.9 weeks (range 28–36 weeks), and the mean intraoperative blood loss was 1902.3 ± 578.8 mL (range 500–8000 mL). Operative bleeding was controlled by conservative treatment without additional surgery in two cases. Importantly, two patients (15.8%) had severe complications possibly related to the interventional procedure. One patient was noted to have a popliteal artery thrombosis. A second patient had an external iliac artery thrombosis with 80–90% occlusion. Both patients required antithrombotic treatment without sequelae.

Conclusion: With limited experience in this small series, we observed a statistically significant reduction in operative blood loss after the use of temporary prophylactic balloon occlusion of the CIA technique compared with historical controls of similar demographic characteristics previously published (1902.3 ± 578.8 mL, range 500–8000 mL vs. 4445.7 ± 996.48 mL, range 1040–15,000 mL, $p = 0.0402$). Additionally, two patients had arterial thrombosis. These preliminary findings are based on a small number of patients, and therefore further investigation is needed to determine the effectiveness and safety of this new technique.

Introduction

Abnormal placentation has become a challenging problem of increasing clinical significance in obstetric practice. Severe abnormal placentation unexpectedly encountered at the time of delivery can lead to catastrophic consequences, such as life-

* Corresponding author. Department of Obstetrics and Gynecology, Taichung Veterans General Hospital, 1650 Section 4 Taiwan Boulevard Road, Taichung 40705, Taiwan.
E-mail address: mmchou@vghtc.gov.tw (M.M. Chou).
[1] M.M. Chou and H.F. Kung contributed equally to this paper.

http://dx.doi.org/10.1016/j.tjog.2014.03.013

threatening hemorrhagic shock, uterine rupture, and even maternal death. Utilization of ultrasonographic and magnetic resonance imaging (MRI) in the setting of conventional risk factors for abnormal placentation (prior cesarean section, placenta previa etc.) allows for accurate prenatal diagnosis and advanced preparation before delivery [1–6], so that an experienced multidisciplinary team can be assembled in advance to manage the potentially dreadful hemorrhagic complications with the optimum strategies to reduce maternal morbidity and mortality.

The most common complication encountered in abnormal placentation is massive hemorrhage, attributed to the development of extensive pelvic collateral circulation in the gravid uterus. We have previously reported an average blood loss of 4445.7 ± 996.48 mL (range 1040–15,000 mL) in a series of placenta accreta [2]. Intraoperative blood loss may necessitate significant blood transfusion with the associated complications of disseminated intravascular coagulation (DIC), fluid overload, pulmonary edema and infection. Other significant surgical morbidities include ureteral injury, and bladder lacerations. In an effort to minimize blood loss and facilitate surgery, intraoperative balloon occlusion of the aorta, common iliac, internal iliac, and uterine arteries has been described in the literature. [7–16]. The theory is that reduced uterine perfusion allows for a more controlled hysterectomy with decreased hemorrhage and surgical complications. To date however, most published literature findings regarding this therapeutic modality have been limited to case reports and case-control comparisons of internal iliac artery catheterization [11–16].

The aim of this study was to investigate the efficacy and safety of temporary prophylactic intraoperative balloon occlusion of the common iliac arteries (CIA) before anticipation of cesarean hysterectomy for controlling operative blood loss in abnormal placentation.

Materials and methods

This was a retrospective, descriptive study performed at the Taichung Veterans General Hospital, Taiwan from January 2007 to December 2009. The institutional review board (IRB C06138) approval was obtained. 13 pregnant women with a diagnosis of placenta previa associated with a prior cesarean delivery, uterine curettage, advanced maternal age, multiparity and/or other associated risk factors, were referred to our institution for detailed evaluations of abnormal placentation. All patients were examined sequentially with 2D ultrasonography (US) followed by 3D US (Voluson 730 Expert; GE imaging system, Kretztechnik, Zipf, Austria) to precisely assess the severity of abnormal placentation before surgical intervention using previously published diagnostic imaging criteria. In addition, preoperative MRI examination (Siemens Sonata 1.5 Tesla scanner; Siemens Medical Solutions, Erlangen, Germany) was used to assess the length and diameter of bilateral common iliac arteries.

On the day of delivery, the patient was taken to the angiography suite, in which, under fluoroscopic guidance, catheterization of the femoral artery was performed by interventional radiologists. A bilateral contralateral approach was used to guide placement of the occlusion balloon catheters (Boston Scientific, Watertown, MA, USA) into the CIA below the aortic bifurcation; they were then inflated with approximately 1–2 mL of iodinated contrast material to test and evaluate the degree of occlusion and obtain the desired complete hemostasis of the CIA (Figure 1). Particular attention was paid to ensure minimal fetal radiation exposure during the procedure, using appropriate shielding and intermittent low-dose fluoroscopy. Total fluoroscopy time is kept as short as possible. Dosimetry studies ranged from 108 mR to 294 mR. The catheters were secured, and the patient was subsequently taken directly to the operating room for planned surgery. After the infant was delivered by classical cesarean section, the balloon catheters of bilateral CIA were inflated using the same volume and pressure as for the test occlusion. A supracervical or total hysterectomy was performed. The balloons were usually inflated intraoperatively to ensure that hemostasis was achieved during the resection of the uterus with the abnormally adherent placenta *in situ*. Periodic local infusion of heparinized saline solution was performed through the sheaths and catheters and they were removed the moment hemostasis was achieved.

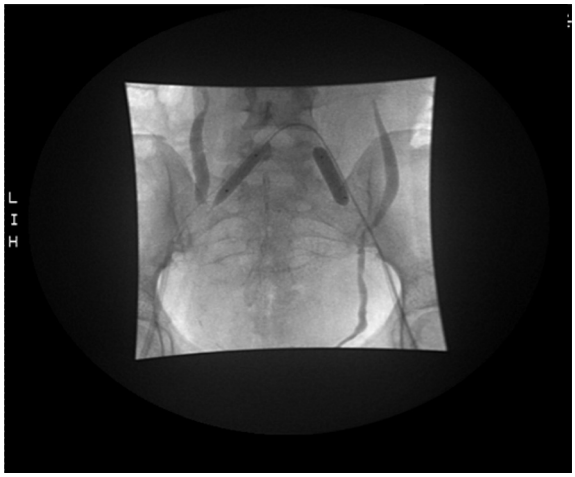

Figure 1. Arteriogram showing two inflated balloon catheters with 1–2 mL of iodinated contrast material placed in the bilateral common iliac arteries just below the aortic bifurcation to occlude the arterial flow in a patient with placenta percreta before cesarean hysterectomy.

During the surgical procedure, pulse oximetry of both feet was established to monitor the arterial oxygen saturation. In addition, periodic pedal arterial pulsation was also regularly checked. Catheter removal was performed at the postoperative recovery room if the patient's hemodynamic status and coagulation profile were unremarkable.

The primary outcome for this study included estimated blood loss (milliliters), and secondary outcomes included the development of thromboembolism, surgical complications, and the need for reoperation. Statistical analysis was performed using SPSS software (version 19; SPSS Inc, Chicago, IL, USA), and a p value < 0.05 was considered statistically significant.

Results

During the study period, 13 patients at risk exhibited characteristic ultrasonographic findings for abnormal placentation, and ultimately had surgical and pathologic confirmation of abnormal placentation. Maternal demographic characteristics are listed in Table 1.

All patients had combined risk factors for placenta accreta. Among these13 patients, the mean age of the patients was 32.8 ± 0.7 years (range 29–37 years). All diagnoses were made in the second and third trimesters, at a mean gestational age of 26.7 ± 1.7 weeks (range 18–36 weeks). The mean gestational age at cesarean hysterectomy was 32.2 ± 0.9 weeks in 11 patients. (range 28–36 weeks). The mean balloon occlusion time was 44.6 ± 2.0 minutes (range 30–50 minutes).

We observed a statistically significant reduction in operative blood loss after the use of the temporary prophylactic balloon occlusion of the CIA technique compared with historical controls of similar demographic groups previously published

Table 1
Maternal demographic characteristics.

Case no.	Age (y)	Risk factors	GA at diagnosis (wk)	GA at delivery (wk)	Interventional and operative procedures	EBL (ml)	Complications	Pathology
1	35	LSCS x 1; AMA; PP	18	19	CIA BO 45 min and TAH	850	N/A	Twin A, percreta; Twin B, normal placentation
2	29	LSCS x 3; PP	27	28	CIA BO 50 min and C/H	8000	Massive blood transfusion	Increta
3	32	LSCS x 2; PP	36	36	CIA BO 50 min and C/H	2800	N/A	Percreta
4	34	LSCS x 2; D&C x 1; PP	27	31	CIA BO 45 min and C/H	750	N/A	Increta/percreta
5	35	AMA; PP	22	34	CIA BO 45 min and C/H	650	N/A	Acereta
6	35	D&C x 5; AMA; PP	21	34	CIA BO 40 min and C/H	650	N/A	Increta
7	37	LSCS x 2; PP	25	29	CIA BO 50 min and C/H	1500	N/A	Increta
8	33	D&C x 1; PP	35	35	CIA BO 30 min; conservative treatment	1600	N/A	Placenta previa plus infarct; clinical and surgical diagnosis of focal accreta increta
9	35	LSCS x 1; PP; AMA	34	34	CIA BO 30 min; conservative treatment	500	Retained placenta managed by UAE and uterine curettage on 33 days postpartum: febrile morbidity with *E. coli* infection	
10	29	LSCS x 1; D&C x 1; PP	33	34	CIA BO 50 min and C/H	500	N/A	Increta
11	31	LSCS x 1: D&C x 1; PP	25	30	CIA BO 45 min and C/H	1850	N/A	Percreta
12	33	D&C x l; Asherman's syndrome; history of uterine perforation; PP	25	29	CIA BO 50 min and C/H	1180	Right popliteal artery thrombosis	Increta
13	29	LSCS x 2; PP	19	21	CIA BO 50 min and TAH	3900	Right external iliac artery thrombosis; febrile morbidity with pelvic hematoma	Percreta with bladder wall invasion

AMA = advanced maternal age; CIA BO = balloon occlusion of the common iliac arteries; C/H = cesarean hysterectomy; D&C = dilatation and curettage; EBL = estimated blood loss; LSCS = lower segment cesarian section; N/A = not applicable; PP = placenta previa; TAH = total abdominal hysterectomy; UAE = uterine artery embolization.

(1902.3 ± 578.8 mL, range 500–8000 mL vs. 4445.7 ± 996.48 mL, range 1040–15,000 mL, $p = 0.0402$).

Among these 13 patients, 11 patients underwent cesarean hysterectomy. Two patients had successful conservative treatment to preserve the uterus after inflating the balloon catheter of the CIA. In the eighth patient, fortunately, the successful manual separation of focal adherent placenta without induced profuse hemorrhage and ensuing hemorrhage was controlled by interrupted circular suture around the bleeding area of the lower segment and rolling gauze packing of the uterine cavity. However, in the ninth patient, delayed postpartum hemorrhage possibly induced by minima endomyometrial injury occurred 5 hours after cesarean delivery, and the bleeding was quickly contained after embolization of both uterine arteries.

Febrile morbidity was observed in two patients. Importantly, two patients (15.8%) had severe complications possibly related to the intervention. One patient was noted to have a popliteal artery thrombosis (Figures 2A and 2B). A second patient had an external iliac artery thrombosis with 80–90% occlusion (Figures 3A, 3B, and 3C). Both patients required antithrombotic treatment with heparin and symptoms and signs resolved without sequelae. Furthermore, there were no maternal deaths in the series.

Discussion

The associated hemorrhagic and surgical complications with abnormal placentation vary significantly depending on the extent of placental invasion, severity of associated uteroplacental hypervascularization, and involvement of adjacent structures such as the bladder or intestine. Correct antenatal diagnosis and the appropriate management strategy can be the difference between life and death because infiltrating placental tissue invades the extensively vascularized lower uterine segment and the bladder, posing a serious risk of life-threatening hemorrhage. Moreover, the surgical dissection of densely adherent placenta to the bladder wall and/or partial cystectomy is a very difficult and bloody procedure.

The abdominal aorta divides, on the left side of the body of the fourth lumbar vertebra, into the two CIA. The length of the arteries varied from 3.5 cm to 7.5 cm (range 1.25–11 cm), and 0.73 cm to 1.14 cm in diameter. The size of the occlusion balloon catheter should be optimally tailored to the anatomically targeted vessels being occluded because a poorly occluded vessel will yield incomplete hemostasis and increased hemorrhage [16]. Preoperative MRI examination can help to choose the appropriate size of the occlusion balloon by evaluating the size and length of the CIA. Theoretically, the blood supply may be interrupted by angiographic means prior to surgery in order to reduce intraoperative blood loss. However, we must emphasize that collateral circulation of the female pelvis, particularly in a condition such as abnormal placentation, is extensive and provides a variety of sources of intercommunication of arterial blood arising from various sites along the pelvic arterial tree such as the obturator, lumbar, sacral, rectal, and femoral arteries. During a difficult hysterectomy, this collateral circulation may create problems in achieving adequate hemostasis.

Theoretically, proximal occlusion of the large vessels such as the aorta and common iliac arteries is more effective, but runs the potential risk of ischemia to the extremities if prolonged occlusion is required [16]. The use of catheter-based balloon occlusion to thwart massive obstetric hemorrhage was first described by Paull et al [7] in 1995 with the use of an 18 mm infrarenal aortic balloon. Soon after, Dubois et al [11] described the successful prophylaxis of two patients with placenta percreta using 8.5 mm occluding balloon catheters placed in the anterior divisions of both internal iliac arteries. Levine et al [12] reported their preliminary findings that transcatheter arterial balloon occlusion procedures did not improve surgical outcomes compared with patients managed without them. However, Kidney et al [13] reported that balloon occlusion of the hypogastric arteries was an effective adjunct to cesarean hysterectomy in an attempt to minimize operative blood loss in patients with abnormal placentation. They suggested that although occlusion

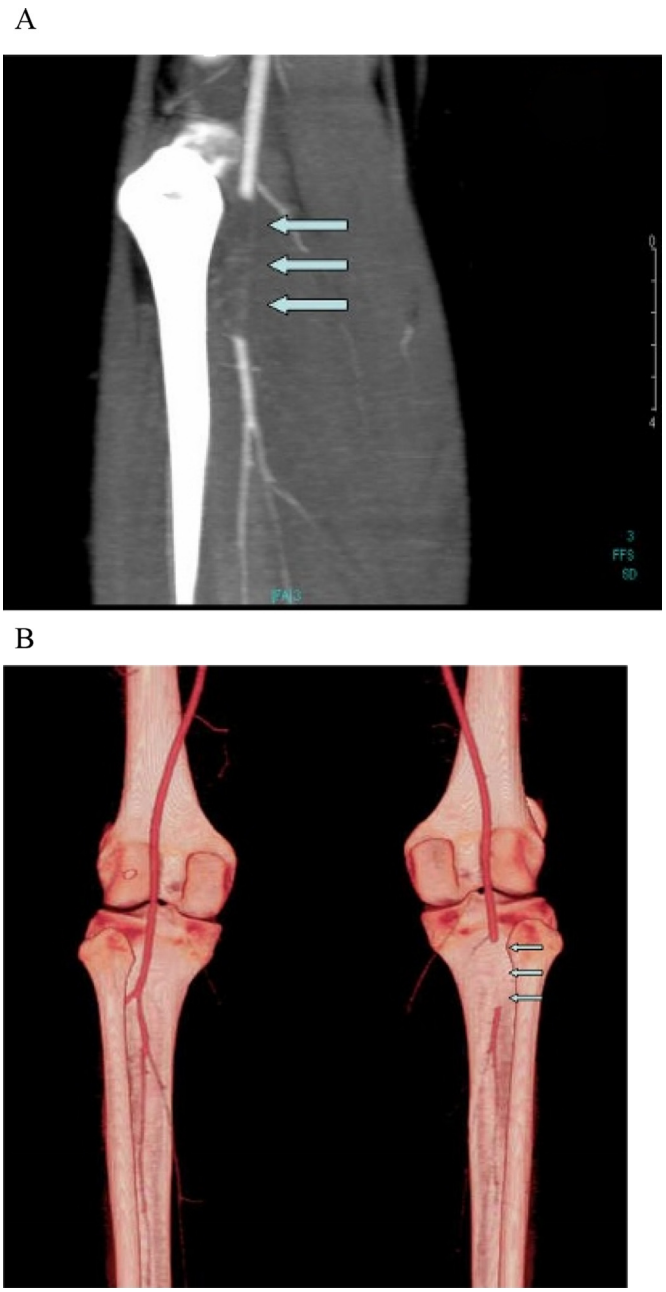

Figure 2. (A) An angiograph using multi-detector computed tomography (MDCT) showing the extent and degree of thrombosis (indicated by arrows) with complete total occlusion of the right popliteal artery. (B) 3D MDCT reconstructed image demonstrating the extent and degree of thrombosis (indicated by arrows) with complete occlusion of the right popliteal artery.

of the hypogastric arteries did not halt blood flow to the uterus because there is a rich supply of collaterals, the technique did reduce the pulse pressure distal to the site of occlusion, thus minimizing blood loss during hysterectomy. In 2006, Bodner et al [14] reported another cohort study of six patients who received temporary balloon occlusion of the bilateral internal iliac arteries (anterior divisions), followed by transcatheter embolization. They used a comparison group of 22 patients with similar demographics and pathology and found no difference in blood loss. They speculated that this lack of success may reflect their inability to preoperatively select the optimal placement site of the occlusion balloons and extensive collateral circulation. An

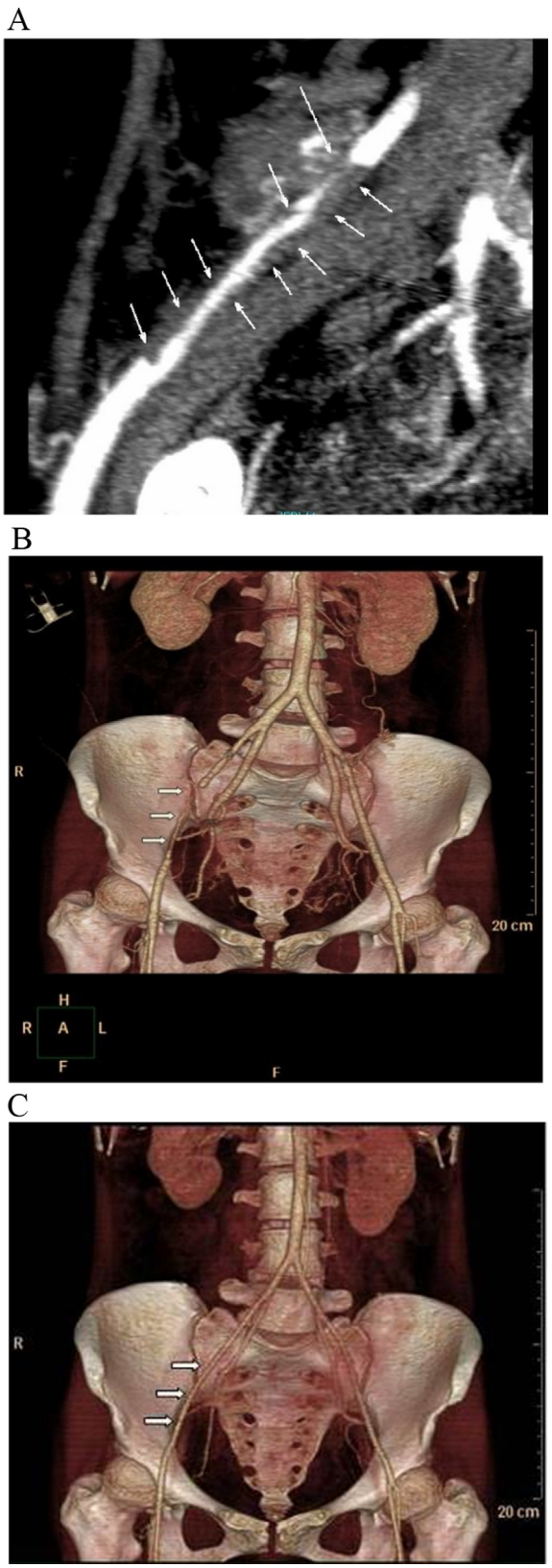

Figure 3. (A) An angiograph showing mural thrombus formation (indicated by arrows) of the right external iliac artery with nearly complete occlusion. (B) 3D multi-detector computed tomography (MDCT) reconstructed image showing mural thrombus formation (indicated by arrows) of the right external iliac artery with nearly complete occlusion. (C) 3D MDCT reconstructed image showing good patency (indicated by arrows) of the right external iliac artery after thrombolytic treatment with heparin injection.

innovative technique of temporary balloon occlusion of the CIA was first described by Shih et al [10] in 2005. This new technique can be used to provide more definitive devascularization than conventional balloon occlusion of the internal iliac arteries.

According to the literature reports, the duration of aortic cross-clamping can be at least 1 hour in surgery for abdominal aortic aneurysm. After an ischemia time of 1–2 hours during aortic aneurysm surgery, muscle glutathione redox-status is not altered, indicating that this ischemic insult is well within the scavenging capacity of muscle glutathione, the most important endogenous scavenger [17]. We suggest that the temporary CIA occlusion is relatively safe (<60 minutes) because of the presence of rich collaterals of abnormal placentation in pregnancy due to increased uteroplacental blood flow to the pelvis, and the lower limbs cannot be totally occluded by the balloon catheter. The potential risks of inflating a balloon in the CIA are rupture of CIA which was less likely in young pregnant patients with good arterial elasticity, dislodgment of a plaque which embolizes in a distal vessel, thromboembolism, and ischemic injury caused by prolonged occlusion.

Nevertheless, studies in 2006 and 2007 by Sewell et al [18] and Greenberg et al [19] on pregnant mothers affected with placenta accreta who underwent prophylactic common and internal iliac balloon catheterization showed that two patients had severe complications of popliteal artery thrombosis and iliac artery thrombosis, respectively. The case report by Sewell et al [18] involved a 37-year-old woman at 37 weeks of gestation with a history of multiple cesarean sections. Interestingly, she received intravenous heparin before and even during her cesarean hysterectomy. Balloons were only inflated for 25 minutes and resulted in acute limb ischemia because of thromboembolism to the popliteal artery. Greenberg et al [19] also reported a case of a 27-year-old woman with placenta percreta with bilateral internal iliac artery balloons who had iliac artery thrombosis and acute iliac artery thrombosis. They offer recommendations for the cautious use of this modality. If used, the most important elements to minimize vascular complications should include early device removal and intense vascular surveillance because of the hypercoagulable state of pregnancy.

Shrivastava et al [20] reported a large case-controlled study of 69 patients who had cesarean hysterectomy performed for placenta accreta. Nineteen patients with preoperative internal iliac artery balloon catheter (BC) placement plus hysterectomy were compared with 50 patients who had hysterectomy alone. No significant differences were noted in estimated blood loss. Importantly, three of the 19 BC patients (15.8%) had severe complications from catheter placement; one patient was noted to have an internal iliac artery thrombosis and groin hematoma. A second patient had an internal iliac artery dissection with 80–90% occlusion. A third patient had a femoral artery thrombosis.

Importantly in our series, we also encountered that 15.4% (2/13) of patients had complications of arterial thrombosis possibly related to the intravascular catheters. It is difficult to ascertain the exact cause for the thrombosis. Possible contributing factors included those related to technique, such as operator experience, duration of catheter placement procedure, number of attempts, and inadvertent luminal endothelium trauma. Passing an inflated balloon catheter down an artery resulted in possible removal and/or destruction of all the endothelial cells in that segment. The following subendothelial reaction was intense and led to complete thrombotic occlusion. Other inherent risk factors to the patients included genetic predisposition to thrombosis by a mutation in an undetermined factor, hemodynamic instability and presence of coagulopathy or its aggressive correction with inappropriate blood transfusion.

The prophylactic use of systemic heparinization may be unnecessary for iliac catheter placement and would only exacerbate ongoing hemorrhage during balloon inflation. The most reasonable alternative is to infuse heparinized saline solution through the sheaths and catheters and to remove them the moment hemostasis is achieved. We believe that novel techniques can be lifesaving and thus should be encouraged, but caution must be exercised, given that anecdotal case reports are the basis for this practice. Special care must be taken due to the hypercoagulable state of pregnancy to decrease the possibility of thromboembolic events and care for them when they occur.

Prophylactic balloon occlusion of the CIA for abnormal placentation should ideally be submitted to prospective, randomized analysis. Unfortunately, the rarity of this entity, its variable presentation, and the fact that its extent is often only revealed at operation, makes this almost impossible.

In conclusion, we believe that best results were achieved with a multidisciplinary approach, in which early radiological consultation was obtained and temporary balloon occlusion of the CIA instituted when indicated, intense vascular surveillance is mandatory, and catheters and sheaths should be removed at the first opportunity. In this small series, we are encouraged by the statistically significant reduction in operative blood loss after the use of the temporary prophylactic balloon occlusion of the CIA. However, importantly, two patients (15.8%) had severe complications possibly related to the intervention. Therefore the safety of this innovative technique remains unclear. We will continue to gather data on subsequent patients, the very limited number of treated patients in this series has not allowed definite conclusions because these findings are not from a randomized controlled study. It is hoped that our preliminary results will stimulate others to develop protocols to assess this new approach to this difficult clinical problem.

Conflicts of interest

The authors declare no conflict of interest.

Acknowledgments

This study was supported by the Medical Research Council of Taichung Veterans General Hospital (TCVGH 966405C).

References

[1] Levine D, Hulka CA, Ludmir J, Li W, Edelman RR. Placenta accreta: evaluation with color Doppler US, power Doppler US, and MR imaging. Radiology 1997;205:773–6.
[2] Chou MM, Ho ES, Lee YH. Prenatal diagnosis of placenta previa accreta by transabdominal color Doppler ultrasound. Ultrasound Obstet Gynecol 2000;15:28–35.
[3] Chou MM, Tseng JJ, Ho ES, Hwang JI. Three-dimensional color power Doppler imaging in the assessment of uteroplacental neovascularization in placenta previa increta/percreta. Am J Obstet Gynecol 2001;185:1257–60.
[4] Chou MM. Prenatal diagnosis and perinatal management of placenta previa accrea: past, present and future. Taiwanese J Obstet Gynecol 2004;43:64–71.
[5] Comstock CH. Antenatal diagnosis of placenta accrete: a review. Ultrasound Obstet Gynecol 2005;26:89–96.
[6] Chou MM, Chen WC, Tseng JJ, Chen YF, Yeh TT, Ho ES. Prenatal detection of bladder wall involvement in invasive placentation with sequential two-dimensional and adjunctive three-dimensional ultrasonography. Taiwan J Obstet Gynecol 2009;48:38–45.
[7] Paull JD, Smith J, Williams L, Davison G, Devine T, Holt M. Balloon occlusion of the abdominal aorta during cesarean hysterectomy for placenta percreta. Anaesth Intensive Care 1995;23:731–4.
[8] Andoh S, Mitani S, Nonaka A, Suzuki S, Tamaki F, Ohmori K, et al. Use of temporary aortic balloon occlusion of the abdominal aorta was useful during cesarean hysterectomy for placenta accreta. Masui 2011;60:217–9 [Article in Japanese].
[9] Panici PB, Anceschi M, Borgia ML, Bresadola L, Masselli G, Parasassi T, et al. Intraoperative aorta balloon occlusion: fertility preservation in patients with

placenta previa accreta/increta. J Matern Fetal Neonatal Med 2012;25:2512–6.
[10] Shih JC, Liu KL, Shyu MK. Temporary balloon occlusion of the common iliac artery: new approach to bleeding control during cesarean hysterectomy for placenta percreta. Am J Obstet Gynecol 2005;193:1756–8.
[11] Dubois J, Garel L, Grignon A, Lemay M, Leduc L. Placenta percreta: Balloon occlusion and embolization of the internal iliac arteries to reduce intraoperative blood losses. Am J Obstet Gynecol 1997;176:723–6.
[12] Levine AB, Kuhlman K, Bonn J. Placenta accreta: Comparison of cases managed with and without pelvic artery balloon catheters. J Matern Fetal Neonatal Med 1999;8:173–6.
[13] Kidney DD, Nguyen AM, Ahdoot D, Bickmore D, Deutsch LS, Majors C. Prophylactic perioperative hypogastric artery balloon occlusion in abnormal placentation. AJR Am J Roentgenol 2001;176:1521–4.
[14] Bodner LJ, Nosher JL, Gribbin C, Siegel RL, Beale S, Scorza W. Balloon-assisted occlusion of the internal iliac arteries in patient with placenta accreta/percreta. Cardiovasc Intervent Radiol 2006;29:354–61.
[15] Chou MM, Hwang JI, Tseng JJ, Ho ES. Internal iliac artery embolization before hysterectomy for placenta accreta. J Vasc Interv Radiol 2003;14:1195–9.
[16] Knuttinen MG, Jani A, Gaba RC, Bui JT, Carrillo TC. Balloon occlusion of the hypogastric arteries in the management of placenta accreta: a case report and review of the literature. Semin Intervent Radiol 2012;29:161–8.
[17] Westman B, Johansson G, Söderlund K, Wernerman J, Hammarqvist F. Muscle glutathione metabolism during ischemia and reperfusion in patients undergoing aorto-bifemoral bypass surgery. Acta Anaesthesiol Scand 2006;50:699–705.
[18] Sewell MF, Rosenblum D, Ehrenberg H. Arterial embolus during common iliac balloon catheterization at cesarean hysterectomy. Obstet Gynecol 2006;108:746–8.
[19] Greenberg JI, Suliman A, Iranpour P, Angle N. Prophylactic balloon occlusion of the internal iliac arteries to treat abnormal placentation: a cautionary case. Am J Obstet Gynecol 2007;197:470.
[20] Shrivastava V, Nageotte M, Major C, Haydon M, Wing D. Case-control comparison of cesarean hysterectomy with and without prophylactic placement of intravascular balloon catheters for placenta accreta. Am J Obstet Gynecol 2007;197:402.